

NOAA Deep- Sea Coral and Sponge Ecosystems Exploration and Research Priorities Workshop for the U.S. South Atlantic

Wilmington, North Carolina – July 7-8, 2009

Introduction

On July 7-8, 2009, scientists and resource managers met in Wilmington, North Carolina to further define the exploration and research priorities laid out in the *NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems*, and to identify critical information needs for deep-sea coral and sponge ecosystems in the U.S. South Atlantic. The ultimate goal of the workshop was to identify steps to improve the understanding, conservation, and management of these ecosystems. Workshop participants represented a broad range of stakeholders including the Federal government, the South Atlantic Fishery Management Council (SAFMC), academia, private industry, and nongovernmental organizations (See Appendix C for a list of participants).

The NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems

The NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems identifies national-level goals, objectives, and approaches to guide NOAA's research, management, and international cooperation activities on deep-sea coral and sponge ecosystems for fiscal years 2010 through 2019. The primary goal of the Strategic Plan is to improve the understanding, conservation, and management of deep-sea coral and sponge ecosystems. The Strategic Plan covers deep-sea coral and sponge ecosystems under the jurisdiction of the United States and international cooperation activities undertaken by the United States.

The Strategic Plan is divided into three sections: (I) Exploration and Research, (II) Conservation and Management, and (III) International Cooperation.

Section I identifies the role of research in management, including NOAA's priorities and objectives for research and exploration of deep-sea coral ecosystems and anticipated products for each objective. The goal of NOAA's exploration and research on deep-sea coral and sponge ecosystems is to provide decision-makers with sound scientific information that will enable effective ecosystem-based management decisions.

Section II lays out objectives and approaches that NOAA will undertake to enhance protection of deep-sea coral and sponge ecosystems working with the Regional Fishery Management Councils, National Marine Sanctuaries (NMS), and other Federal agencies and partners. NOAA's strategy for managing deep-sea coral and sponge ecosystems is centered on the authority provided to NOAA through the Magnuson-Stevens Conservation and Management Act and the National Marine Sanctuaries Act.

Section III describes NOAA's participation in international activities to protect and/or conserve deep-sea coral and sponge ecosystems.

The Strategic Plan provides guidance for all NOAA programs supporting research, management, and international cooperation activities on deep-sea coral and sponge ecosystems. Within NOAA,

these activities are coordinated through the Coral Reef Conservation Program (CRCP), a matrix program consisting of four NOAA line offices – the National Ocean Service (NOS); National Marine Fisheries Service (NMFS); National Environmental, Satellite, and Data Information Service (NESDIS); and Office of Oceanic and Atmospheric Research (OAR).

NOAA, through the CRCP, will implement the national Strategic Plan by further refining the objectives and approaches stated therein to address issues at the regional level. This workshop focuses on further refining Section I: Exploration and Research of the Strategic Plan to identify critical information needs for the U.S. South Atlantic region, which includes waters under U.S. jurisdiction of the Atlantic Ocean off the coasts of North Carolina, South Carolina, Georgia and east Florida to Key West.

About the Workshop

The goal of the workshop was to identify exploration and research priorities for the next five years for deep-sea coral and sponge ecosystems in the U.S. South Atlantic that address resource management needs. The workshop was hosted by the University of North Carolina at Wilmington (UNCW) and organized by NOAA's CRCP. A Steering Committee consisting of representatives from NOAA (OAR, NOS, and NMFS) and the SAFMC and in cooperation with the National Undersea Research Center at UNCW presided over the development of the workshop's goals, objectives, schedule, and final summary.

The workshop consisted of presentations highlighting national and regional plans; breakout groups to identify and refine critical information needs, and plenary discussions (See Appendix A: Workshop Agenda).

National and Regional Plans. To set the context for identifying critical information needs, several presentations were given to provide an overview of national and regional plans. The presentations included an overview of NOAA's Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation; the SAFMC *Deepwater Coral Research and Monitoring Plan*; and priorities identified by NMS for exploration and research on deep-sea corals. Additionally, an overview was provided on the academically-driven Trans-Atlantic Coral Ecosystems Study, a scientific program designed to investigate deep-sea coral communities found along the continental shelf break and slope, and in association with canyons and seamounts in the North Atlantic Ocean.

Breakout Groups. Workshop participants were divided into four¹ separate breakout groups based on the exploration and research objectives identified in the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems:

- **Locating and characterizing** deep-sea coral and sponge ecosystems;
- Understanding the **biology and ecology** of deep-sea corals and sponges;
- Understanding the **biodiversity and ecology** of deep-sea coral and sponge ecosystems; and
- Understanding **natural and human impacts** (including past oceanic conditions).

¹ The Exploration and Research Strategy section of the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems has five objectives. Objectives 4 and 5 were combined into a single working group (i.e., understanding natural and human impacts) for the workshop. However, due to missing expertise at the workshop this group solely focused on natural and human impacts.

Each participant was provided with priorities identified in the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems and in the SAFMC Deepwater Coral Research and Monitoring Plan to use as a starting point. Each breakout group was tasked with identifying and prioritizing critical information needs; identifying activities for the next five years; and prioritizing the activities. Activities were then prioritized based on whether they addressed critical information needs or gaps; addressed a management need; were financially feasible; and whether they had the potential for leveraging funds and/or collaboration with other funded programs. (See Appendix B for the Breakout Group Participation List).

Plenary Discussions. During plenary sessions, workshop participants were provided the opportunity to discuss, refine, and prioritize critical information needs identified by individual breakout groups. To determine the highest priority, each participant was given two dots and asked to place the dots on (or vote for) the critical information need that they believed to be the highest priority. The results of the group prioritization exercise are in Table 1.

Table 1. Prioritized activities identified by the participants.

Critical Information Need	Group Prioritization Exercise (# of votes)
Objective #1: Locate and Characterize	
• Complete multi-beam sonar surveys for the SAFMC proposed Deepwater Coral Habitat Areas of Particular Concern (CHAPCs).	11
• Explore and characterize sites of interest identified within the CHAPCs after completing multi-beam sonar surveys.	5
• Develop modeling tools to predict where corals are likely to occur.	2
Objective #2: Biology and Ecology	
• Inventory deep-sea coral species distribution and abundance.	1
Objective #3: Biodiversity and Ecology	
• Describe types, strengths, and patterns of habitat association of deep-sea corals and sponge with other species.	8
• Assemble an interdisciplinary team to integrate tasks to better understand deep-sea coral species and habitat relationships.	1
Objective #4: Understand natural and human impacts	
• Identify and assess impacted areas from fishing and non-fishing activities.	3
• Map fishing of commercial and deep drop recreational efforts.	1

Critical Information Needs

During the two-day workshop, considerable progress was made to identify and prioritize exploration and research information needs. Each participant was placed in one of the four breakout groups based on their expertise. The four breakout groups were based on the objectives identified in the Exploration and Research Section of the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems and are:

- **Locating and characterizing** deep-sea coral and sponge ecosystems;
- Understanding the **biology and ecology** of deep-sea corals and sponges;
- Understanding the **biodiversity and ecology** of deep-sea coral and sponge ecosystems; and
- Understanding **natural and human impacts** (including past oceanic conditions).

The breakout groups relied heavily on the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems and the SAFMC Deepwater Coral Research and Monitoring Plan.

The product from each breakout group consisted of a list of critical exploration and research information needs and activities to be conducted to address those needs, as well as potential areas of future collaboration. In Plenary sessions, workshop participants prioritized the critical information needs/activities (see section on Plenary discussions for information on how the prioritization was done). The three highest priorities activities identified by the participants were:

- Map and characterize deep-sea coral habitats in the proposed CHAPCs.
- Understand species and coral habitat relationships and the factors that control or influence them.
- Conduct research to identify and assess areas impacted by fishing and non-fishing activities.

For all exploration and research information needs and activities identified the highest priorities in general were for the work to be conducted in the proposed CHAPCs and areas where there is potential overlap between the CHAPCs and the golden crab and deepwater shrimp fisheries in an effort to identify “allowable gear areas” within the CHAPCs.

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The following represents a summary of the critical information needs developed by each breakout group.

Objective #1: Locate and characterize deep-sea coral and sponge ecosystems.

Deep-sea coral ecosystems occur along the southeastern coast of the United States from North Carolina to the southwestern Gulf of Mexico. Areas where deep-sea coral ecosystems have been identified include: 1) *Oculina* banks – the banks are located off the east-central coast of Florida in depths of about 50 m, although *Oculina* corals occur as scattered colonies in shallow and deep waters throughout the region; 2) North Carolina *Lophelia* mounds—three mound systems represent the northernmost deep-sea coral ecosystems in the South Atlantic Bight; 3) Stetson Reefs—hundreds of pinnacles up to 152 m tall at depths of 640 to 900 m on the eastern Blake Plateau off South Carolina and Georgia; 4) Savannah Lithoherms—numerous lithoherms at depths of 490 to 550 m with up to 60 m vertical relief; 5) East Florida *Lophelia* Reefs—hundreds of 15-152m tall coral bioherms and lithoherms at depths of 600 to 870 m along the shelf margin from southern Georgia to the Straits of Florida; 6-7) Miami and Pourtales Terraces—relict phosphoritic limestone bank-margin hardgrounds and escarpments extending from Boca Raton to Key West at depths of 200 to 600 m; and 8) Southwest Florida Lithoherms—dozens of 15m tall *Lophelia* lithoherms at 500 m in the eastern Gulf of Mexico. Only a small percentage of these sites has been investigated beyond fathometer transects; each new exploratory expedition discovers new sites. Many more coral sites are likely, and the full extent of topographic features such as the Charleston Bump on the Blake Plateau remains unknown. Similarly, the distribution of possible deep-sea coral ecosystems along the southern margin of the Florida peninsula south of Miami and along the Florida shelf margin in the Gulf of Mexico are largely uninvestigated. Only a small portion of this region has been mapped using ship based multibeam sonar; maps from the North Carolina coral mounds and a portion of the Stetson Banks revealed numerous new features, suggesting that the coral habitat is much more extensive than previously thought.²

Critical Information Needs:

Mapping and site characterization:

1. Inventory existing data (i.e., high- and low-resolution maps, and site characterizations) for the South Atlantic region; prioritize data gaps for future mapping and characterization of known sites; and prioritize mapping areas by Fishery Management Council needs, National Marine Sanctuary needs, and general NOAA needs.
 - Priority locations to inventory first: areas of potential conflict with the Golden Crab fishery, Charleston Bump, North Carolina *Lophelia* mounds, Miami and Portales Terrace, and *Oculina* banks.
2. Complete multibeam sonar surveys for the proposed CHAPCs.
3. Explore and characterize sites of interest identified within the CHAPCs after completing multibeam sonar surveys.
4. Conduct high-resolution site characterization of areas identified as gaps from inventory of existing data.

² Introductory text for each objective, with slight modification, is from the South Atlantic Fishery Management Council's *Research and Monitoring Plan for Deepwater Coral of the South Atlantic Region* (2007).

Modeling³: Develop modeling tools to predict where corals are likely to occur.

1. Identify preferred habitat classification scheme (e.g., SEADESC, Greene et al., or Allecetal), and key parameters (e.g., temperature and current speeds).
2. Create outputs that include print and electronic maps and GIS compatible information.
3. Evaluate the validity of model predictions by ground-truthing potential new locations.

Note: Participants at the workshop recognized during initial group discussions that the inventory and analysis of existing data was a known need and in many instances a requirement to adequately address the critical information needs identified under each of the objectives. Participants agreed that the inventory and analysis of existing data would not be developed further as a separate critical information need.

³The breakout group to *Understand the Biology and Ecology of Deep-sea Coral Sponges* also identified modeling as a priority information need.

Objective #2: Understand the biology and ecology of deep-sea coral and sponges.

Our understanding of deep-sea coral ecosystems within the U.S. has progressed rapidly over the past decade, primarily through a series of exploratory cruises that have provided information on the distribution and general characteristics of these valuable ecosystems. The next steps involve addressing ecosystem function and resilience to change, both anthropogenic and natural. In the South Atlantic region, deep-sea coral ecosystems dominated by *Lophelia pertusa* and *Enallopsammia profunda* create extensive and complex structural framework which provides settlement substrate and microhabitat for a diverse benthic fauna. An understanding of individual and population level biology of these foundation species is a pre-requisite to effective ecosystem management. Increasing our understanding of the biology of the keystone species, at an individual and population level will provide baseline data from which to assess ecosystem response to future stressors. At the individual level, factors such as growth rate, skeletal density, and fecundity can change in response to environmental stress.

Critical Information Needs:

Demographics:

1. Inventory deep-sea coral species distribution and abundance.
2. Identify habitat forming deep-sea coral and sponge species between 50 and 1000 meters.
3. Develop a network of taxonomic experts and protocols for collection, sample and data distribution.

Recruitment, connectivity and reproduction:

1. Describe the basic biology or life history (e.g., reproductive strategies, feeding habits and patterns, dispersal strategies, and recruitment) of deep-sea coral species (i.e. stony, gorgonians, and black corals) found in CHAPCs.
2. Collect samples from CHAPCs for genetic analysis and determine population dynamics.
3. Conduct field studies to understand the connectivity between shallow, mesophotic, and deep-sea corals.

Objective #3: Understand the biodiversity and ecology of deep-sea coral and sponge ecosystems.

Ongoing research on deep-sea corals in the U.S. South Atlantic has been based on the premise that these habitats are ecologically important and productive, yet very little is known about their ecological roles. The U.S. South Atlantic harbors over 100 deep-sea coral species, some of which create extensive, complex reef structures. These complexes are hotspots of increased biodiversity. Many coral species are very long lived (hundreds to thousands of years), and serve as natural repositories of data on climate, ocean physics, and ocean productivity. However, research on this topic is just beginning as is research on population and community genetics. There are no studies on trophic ecology or energetic models for deep-sea corals of the U.S. South Atlantic.

Deep-sea coral habitat now appears to be more important to northwestern Atlantic slope species than previously thought. However, it is unclear whether this habitat is essential to selected fishes or invertebrates or whether they occupy it opportunistically. Coral thickets, coral rubble, and the less structured nearby non-reef habitat all support diverse faunas in the U.S. South Atlantic. Analyses indicate that many species of fishes and invertebrates are closely associated with the unique deep-sea coral habitat, including commercially-exploited deepwater species (e.g., wreckfish and golden crabs) and potentially exploitable species (e.g., royal red shrimps, blackbelly rosefish, beryciform fishes, barrelfish, and eels). However, reef-invertebrate associations may be more opportunistic than those found in certain reef fishes, but more data are required to confirm these associations.

Critical Information Needs:

Ecology:

1. Describe the types, strengths, and patterns of habitat association of deep-sea corals and sponges with other species.
 - Characterize the factors (e.g. depth, latitudinal gradient) that control and/or influence species relationships.
 - Determine the importance of deep-sea coral and sponges to ecologically and economically important species.
2. Determine the degree to which deep-sea coral and sponge habitats serve as hot spots of marine biodiversity.
3. Document all species associated with deep-sea corals and their frequency of occurrence.
4. Integrate broad scale sampling sites and core sites within the CHAPCs to understand seasonal and decadal patterns.
5. Assemble an interdisciplinary team to integrate tasks to better understand deep-sea coral species and habitat relationships.

Connectivity:

1. Examine reproductive biology of deep-sea corals (i.e. histological analysis, seasonal sampling and behavioral analysis in situ).
2. Conduct post larval to pre adult deep-sea coral habitat studies to determine settlement sites, periodicity, distribution, and relevance to oceanography.

Objective #4: Understand natural and human impacts (including past oceanic conditions).

In the U.S. South Atlantic, two potential threats: fossil fuel development and bottom fishing, create a time-sensitive need to map and characterize these habitats. A moratorium on oil and gas exploration in Florida waters has long prevented impact from fossil fuel extraction; however, recent U.S. legislation directed at expanding energy production in the Gulf of Mexico, coupled with exploration by Cuba in waters adjacent to the Florida Keys, has expanded this threat. Liquefied natural gas, re-gassification facilities, and several proposed natural gas pipelines and offshore facilities could also directly impact local deep-sea coral ecosystems. With respect to fishing, deep-sea coral ecosystems worldwide have been seriously impacted by bottom trawls. In Florida waters, unprotected portions of the *Oculina* Bank off the central east coast (75-100 meters depth) have been severely affected by overfishing and bottom trawling. The continuing depletion of coastal fisheries may expand fishing efforts into deeper habitats in search of valuable commercial species such as royal red shrimp, other shrimps and crabs, wreckfish, and other fish species (some not yet exploited).

Critical Information Needs:

Human Impacts:

1. Identify and assess impacted areas from fishing and non-fishing activities.
 - Priority locations are CHAPCs, shelf edge Marine Protected Areas, allowable gear areas (i.e. Miami Terrace) and cable locations.
2. Monitor coral recovery.
 - Identify and develop technologies to monitor coral recovery and enforce deepwater CHAPC designations.
3. Determine appropriate mitigation strategies.
 - Develop buffers between human activities and known deep-sea coral and sponge resources in CHAPCs.
 - Focus efforts on age, growth, recruitment, and mortality studies of structure forming deep-sea coral species; and develop models to predict status and trends.
 - Understand recovery rates and restoration trajectories.
 - Develop and implement compensatory actions.
4. Increase coordination efforts between federal, state, and local agencies.

Mapping:

1. Map both fishing (i.e. commercial and deep drop recreational efforts) and non-fishing activities (i.e. cable and alternative energy installation, and oil and gas).
2. Develop a standardized mapping and habitat characterization protocol for industry (i.e. Oil and gas, Hydrokinetic activities, and Telecommunication cables) to assess resource impacts.

Conclusion

The Deep-Sea Coral and Sponge Ecosystems Exploration and Research Priorities Workshop provided an opportunity for scientist and resource managers to identify and prioritize critical information needs to increase our understanding of deep-sea coral and sponge ecosystems in the South Atlantic region. The information provided by the participants is an initial step that will help to inform future budget allocations for the U.S. South Atlantic; ensure that research activities address management needs and maximize opportunities to utilize regional expertise; and leverage and complement existing regional efforts.

Appendix A: Workshop Agenda

**NOAA South Atlantic Deep-Sea Corals
Exploration and Research Priorities Workshop
July 7-8, 2009
University of North Carolina, Wilmington
Agenda**

GOAL:

- To develop a five-year exploration and research action plan for deep-sea corals in the U.S. South Atlantic that addresses resource management needs.

OBJECTIVES:

- Reach consensus on the five-year framework for the exploration and research objectives.
- Reach consensus on the exploration and research critical information needs for each objective.
- Develop a concise description of the exploration and research priority activities.

Day 1 – Identifying Deep-Sea Corals Critical Information Needs

8:00	Registration and Coffee
8:30	Welcome and Presentation on NOAA's Deep-Sea Coral Plan (Kacky Andrews) <ul style="list-style-type: none">- <i>Overview of deep-sea coral (mandates, new funding, etc.)</i>- <i>Explain why we are here</i>- <i>What we hope to accomplish in the workshop?</i>- <i>Set expectations for how input will be used</i>- <i>Introduce facilitators</i>
8:45	Review Agenda (Facilitators) <ul style="list-style-type: none">- <i>Meeting objectives, ground rules and process</i>
9:00	NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems (Robert Brock)
9:30	South Atlantic Fisheries Management Council Plan (Myra Brouwer)
9:50	National Marine Sanctuary Priorities (George Sedberry)
10:10	Trans-Atlantic Coral Ecosystem Study (Steve Ross)
10:30	Break

10:50	Discuss Framework Overview (Plenary) - <i>Provide an overview of action plan objectives:</i> <ul style="list-style-type: none"> • <i>Locate and characterize deep-sea coral and sponge ecosystems</i> • <i>Understand the biology and ecology of deep-sea corals and sponges</i> • <i>Understand the biodiversity and ecology of deep-sea coral and sponge ecosystems</i> • <i>Understand natural and human impact (including past oceanic conditions)</i>
11:35	Lunch
12:35	Develop an Outline of Critical Information Needs (Breakout Groups) - <i>Purpose for the afternoon is to develop, assess, and prioritize needs under the objectives</i>
2:05	Breakout Groups Present Critical Information Needs to Entire Group (Plenary)
3:20	Break
3:40	Prioritize Critical Information Needs (Breakout Groups)
4:40	Discuss Accomplishments and Next Steps (Plenary)
5:00	Optional – Tour of Science Center
5:30	End of Day 1 - <i>Dinner “on your own”</i>

Day 1 Products:

- A working outline of critical information needs for each objective.
- Prioritized critical information needs for each objective.

Day 2 – Planning Activities for Deep-Sea Corals

8:30	Summarize Day 1 and Activities for Day 2 (Facilitators) <ul style="list-style-type: none">- <i>Summarize Day 1 accomplishments</i>- <i>Review agenda for Day 2</i>
8:45	Develop Exploration and Research Activities (Breakout Groups) <ul style="list-style-type: none">- <i>Identify a short list of activities based on applied criteria, i.e.</i><ul style="list-style-type: none">o <i>Addresses a critical information need</i>o <i>Addresses a critical gap</i>o <i>Addresses a management need</i>o <i>Financially feasible</i>o <i>Potential for leveraging and collaborations</i>- <i>Simple classification of activities: Existing vs. New Starts</i>
10:45	Break
11:05	Identify Opportunities and Restraints for Activities (Plenary) <ul style="list-style-type: none">- <i>Review and assess activities</i>- <i>Identify additional activities based on information gaps</i>
11:35	Prioritize Activities (Breakout Groups)
12:05	Lunch
1:05	Breakout Groups Present Activities to Entire Group (Plenary)
2:05	Discuss Accomplishments and Next Steps <ul style="list-style-type: none">- <i>Actions coming out and follow up issues</i>
2:30	End of Workshop

Day 2 Products:

- Table of activities based on the critical information needs.
- Prioritized list of activities for consideration in out years.

Appendix B: Breakout Group Participation List

OBJECTIVE 1: <i>Locate and characterize deep-sea coral and sponge ecosystems</i>	
NAME	AFFILIATION
Ed Bowlby	NOAA Ocean Service
Kathryn Scanlan	US Geological Survey
*George Sedberry	NOAA Ocean Service
Curt Whitmire	NOAA Marine Fisheries Service

OBJECTIVE 2: <i>Understand the biology and ecology of deep-sea corals and sponges</i>	
NAME	AFFILIATION
Sandra Brooke	Marine Conservation Biology Institute
Grant Gilmore	Estuarine, Coastal and Ocean Services, Inc.
Stacey Harter	NOAA Marine Fisheries Service
John Reed	Harbor Branch Oceanographic Institute
*Jennifer Schull	NOAA Marine Fisheries Service

OBJECTIVE 3: <i>Understand the biodiversity and ecology of deep-sea coral and sponge ecosystems</i>	
NAME	AFFILIATION
*Robert Brock	NOAA Marine Fisheries Service
Aleta Hohn	NOAA Marine Fisheries Service
Jeff Hyland	NOAA Ocean Service
Steve Ross	University of North Carolina at Wilmington

OBJECTIVE 4: <i>Understand natural and human impact (including past oceanic conditions)</i>	
NAME	AFFILIATION
Myra Brouwer	South Atlantic Fishery Management Council
*Tom Hourigan	NOAA Marine Fisheries Service
Jocelyn Karazsia	NOAA Marine Fisheries Service
Andy Shepard	University of North Carolina at Wilmington

*Objective Leader

Appendix C: Participant List

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**Not in Attendance

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Andy Shepard	University of North Carolina at Wilmington	910-962-2446	sheparda@uncw.edu
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